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The function and role of bifaces in the Late Middle Paleolithic of southwestern France examples from the Charente and Dordogne to the Basque Country

Michel Brenet [a, b, *], Jean Pierre Chadelle [b, c], Émilie Claud [a, b], David Colonge [a, d], Anne Delagnes [b], Marianne Deschamps [d], Mila Folgado [a, b], Brad Gravina [b], Ewen Ihuel [c, e]

[a] INRAP, Domaine de Campagne, 24260 Campagne, France
[b] UMR 5199 PACEA, Université Bordeaux, bâtiment B18, 33615, France
[c] Service Archéologique, Conseil Général de la Dordogne, 2 rue Paul-Louis Courier, 24019 Périgueux, France
[d] UMR 5608 TRACES, Université Toulouse Jean Jaurès, Maison de la Recherche, 5 allée Antonio Machado, 31058 Toulouse, France
[e] UMR 7055 Préhistoire et Technologie, Maison René Ginouvès, 21 allée de l'université, 93023 Nanterre, France

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ABSTRACT

While Late Middle Palaeolithic industries are characterized by a well-documented diversity of stone tool types and blank production methods, the latter of which can at times be exclusively represented in certain assemblages, the bifacial tool component sometimes portrays clear similarities in use and manufacture method. Beyond sharing both comparable volumetric structures and arrangement of active and or prehensile areas, the recurrence in several assemblages of specific groups of bifacial tools used mostly for butchery is particularly striking.

Here, we address several techno-economic and cognitive aspects of biface production and use combined with a consideration of their context. Is the same degree of variability in function and manufacture method equally visible in the retouched tool component? What scales of mobility or technical use-lives do these different bifacial tools portray? Do certain highly elaborate flake tools also reflect equally complex behaviors? How to interpret the presence of carefully manufactured pieces in non-local raw materials alongside others made in local varieties that are hardly reduced but nevertheless equally functional? Finally, which components may have carried a symbolic value or shed light on technical abilities or functional objectives evident in the conception, elaboration, use, and ultimate fate of these bifacial pieces.

Several recently analyzed assemblages with a relatively significant bifacial component from the Charente, Dordogne and the Pyrénées-Atlantiques departements show certain similarities or important differences. In characterizing the coexistence of flake production and bifacial-shaping, we attempt to reveal to what extent and in which ways certain bifacial tools stand out. When combined with technological and cognitive considerations, this approach provides new insights on an important behavioral facet of Neanderthal groups who occupied the Aquitaine Basin after the Last Interglacial.

1. Introduction

Late Middle Paleolithic industries from southwestern France, across the Aquitaine Basin as well as the Basque Country, are characterized by the proliferation of blank production methods, which at times can be exclusive. While these methods are clearly technologically distinct, involve different volumetric core conceptions and specific morphologies of associated retouched tools and blank types, bifacial tools sometimes display clear consistencies, if not similarities, both in their manufacture method and location of active and prehensile areas. An instructive example is the recurrent presence of bifaces with convergent or transverse edges, sometimes used exclusively for butchery, and less often to work wood. Here we explore the variability and coherence of Late Middle Paleolithic lithic production methods through a consideration of

* Corresponding author. INRAP, Domaine de Campagne, 24260 Campagne, France.
E-mail address: michel.brenet@inrap.fr (M. Brenet).

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several technological, functional, economic and cognitive aspects of bifacial tools.

By examining raw material exploitation and transport patterns and the types of blanks employed for the manufacture of bifacial tools it is possible to detect revealing differences with those documented for the flake tool component. By the same token, the degree of variation in manufacturing methods and blank choice between bifacial and flake tools may reveal specific morphologies intended for particular subsistence activities. Moreover, the coexistence of carefully made bifaces on non-local raw materials with less heavily reduced but nevertheless functional examples on local materials pose interesting questions concerning tool use-life and aspects of both inter- and intra-site mobility patterns. To better inform our interpretations of the function, role, evolution and potential originality of these tools it is necessary to address the influence of local contingencies, functional needs, and technical skills.

Here, we present several recently studied lithic assemblages dated to marine isotope stages (MIS) 3 and 4 from the Charente-Maritime, Charente, Dordogne and Pyrénées-Atlantiques departements of Southwestern France. These eleven sites, nine open-air locations and three rock shelters (Fig. 1), produced assemblages with a bifacial component displaying certain techno-economic similarities as well as differences. Here we examine the coexistence of flaked and shaped tools in order to evaluate to what extent bifacial tools are distinct within these assemblages. In addition to technological aspects, this approach to bifacial tools sheds light on significant behavioral and social aspects of the Neandertal groups that occupied the Aquitaine Basin after the Last Interglacial. The open-air site of Bessinaudes (Dordogne) has been included for comparative purposes since its Middle Paleolithic level has been attributed to the end of MIS 5.

2. Methodology

The methodology employed here for investigating Middle and Lower Palaeolithic bifacial tools is based on a techno-functional approach that integrates not only the final form of these objects but also attempts to reconstruct the *chaîne opératoire* of their

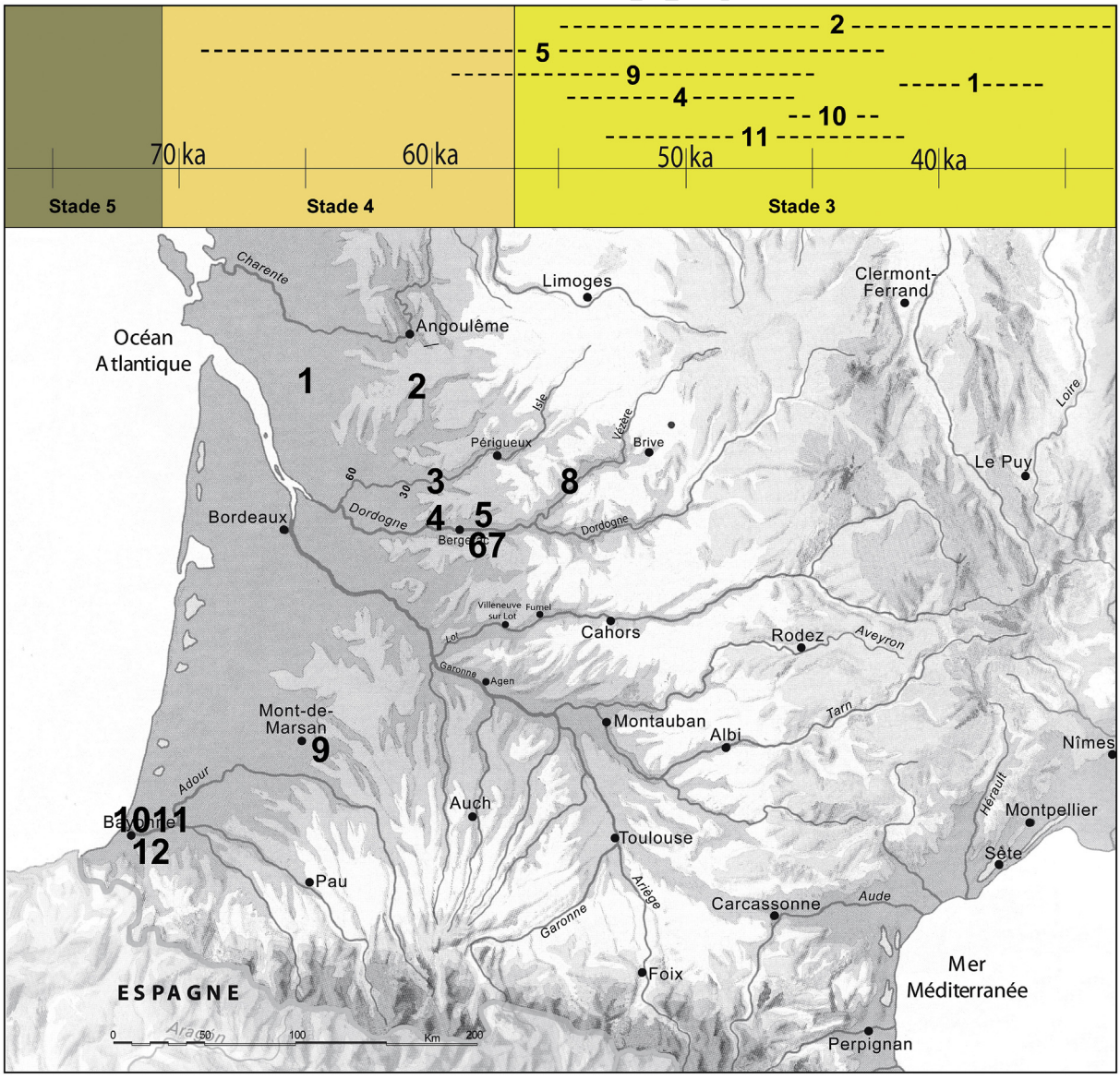

Fig. 1. Chronology and location of the 12 lithic assemblages studied. Chez Pinaud (1), La Chauverie (2) Les Bessinaudes (3), Bout des Vergnes (4), Combe Brune 2 (5), La Conne de Bergerac (6), La Graulet (7), Le Moustier (8), Latrote (9), Le Prissé (10), Le Chemin de Jupiter (11), Le Basté (12).

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production, use, and maintenance from raw material procurement to discard (Boëda et al., 1990, 2004; Boëda, 1995, 2001; Brenet, 1996, 2011; Soressi, 1997, 2002; Soriano, 2000, 2001; Pinoit, 2001; Claud, 2008). Independent of the degree of shaping, this approach focuses on the volumetric structure (e.g. symmetric biconvex, asymmetric plano-convex) and the potentially active or prehensile areas of the tool, termed *techno-functional units* (TFU), that are maintained and transformed as needed. These TFU are determined according to their position and morphological or functional character, including the form and angle of the edges, delineation as well as the type and degree of shaping (Lepot, 1993). Bifacial tools sharing recurrent patterns in the organisation of prehensile and active areas were classed into different *morphotypes,* most commonly, examples with convergent lateral cutting edges and either a pointed or oblique apical zone or pieces with a transverse apical cutting edge.

3. The sites and their biface assemblages

3.1. Chez Pinaud SU-SW 06 and 07 (Jonzac, Charente-Maritime)

Stratigraphic units (SU) 6 and 7 AMS ^{14}C dated to 41,179 ± 1583 and 41,575 ± 982 Cal BP, respectively, of the south-western sector of this rock shelter were excavated under the direction of J. Jaubert across a dozen square meters between 2004 and 2007. A burned flint from SU 6 also yielded a thermoluminescence date of 39 ± 3 ka. The lithic industry comprises 2800 pieces, mostly on locally available Senonian flint. The assemblage is composed primarily of flakes (n = 2451, 92.5% of the total assemblage), 156 of which are retouched, alongside 156 cores. Discoid and Levallois flaking methods coexist with a bifacial tool component represented by 170 bifacial-thinning flakes and 36 (Claud, 2008; Jaubert et al., 2008).

Most of the bifaces were manufactured on-site in local Senonian flint, with a smaller component made on Upper Turonian flint procured approximately twenty kilometers to the north-west (Park *in* Jaubert et al., 2008). The assemblage also includes a single biface in a quartzitic sandstone of probable alluvial origin. While bifaces with convergent edges made on flake blanks dominate, examples deformed by notches and irregular edge maintenance or accidents at the end of their use-life are also present. Use-wear preserved on 18 bifaces is consistent with the butchery of large bovids and horses. Additionally, eleven pieces were recycled and reused either as retouchers or opportunistic hammerstones for percussion on hard mineral materials (Fig. 2) (Claud, 2008; Thiébaut et al., 2010; Claud, 2012).

3.2. La Chauverie (Ronsenac, Charente)

Excavated from 1999 to 2006 under the direction of J. F. Tournepiche, the cave of La Chauverie yielded extremely rich faunal deposits overlying numerous cave hyena occupations and dated to between 54 ka and 33 ka BP (^{14}C dates) (Tournepiche et al., 2005; Discamps et al., 2012). In addition to an unattributable quartzite component (32 pieces) and five Chatelperronian blades, the site also yielded a Mousterian lithic assemblage of approximately one hundred flint artifacts from 4 distinct spatial and stratigraphic assemblages: the lower and upper assemblages of the central sector, the upper silt, and the northern sector (Fig. 3).

More than half of the flint artifacts are made from non-local raw materials; Turonian flint from 20 to 30 km away and Senonian flint from around fifteen kilometers to the south or east. The possibility that several Santonian flint artifacts derive from sources nearly 70 km to the north-west remains to be verified. End-products and finished tools from all four assemblages (24 Levallois flakes, 9 scrapers and 7 bifaces) are generally over-represented relative to flakes and by-products of biface production. When considered alongside the absence of cores and conjoins, this probably indicates a large proportion of the assemblage to have been imported as finished tools. This type of lithic assemblage is typical of specialized sites characterized by brief occupations or stop-overs mostly dedicated to the use and reduction of imported, finely made tools with long use-lives and the absence of evidence for on-site knapping. This behavioral and techno-economic interpretation of the La Chauverie assemblage is consistent with the high mobility and discard state of the finished products, particularly the fragmentation of 5 of the 7 bifaces and the often segmented *chaînes opératoires* associated with the Mousterian of Acheulean Tradition (MTA) (Soressi, 2002; Delagnes and Rendu, 2011).

3.3. Les Bessinaudes (Mussidan, Dordogne)

Dated to 80.4 ± 6 ka by OSL and excavated in 2011–2012 under the direction of J.-P. Chadelle, this level yielded 6200 lithic artifacts (5989 in flint, 203 in metamorphic rocks), 98.5% of which originates from immediate or nearby alluvial deposits of the Isle River, with 1.5% deriving from more distant sources, including a Mousterian point in "*grain de mil*" flint from the Jonzac region (Charente-Maritime). Flake production is represented by 599 cores and 4500 flakes. The Levallois method is best represented (227 cores and 884 flakes), accompanied by a smaller Discoid (112 cores and 167 flakes) and non-Levallois laminar (16 cores and 223 flakes) component.

Flint tools are relatively rare, comprising 153 retouched flakes and 17 bifacial pieces (0.3% of the industry, 10% of the tools). Several different bifacial tool morphotypes are present: bifaces with lateral convergent edges, lateral convex edges, or apical transverse edges. Found at the periphery of the flake production zones and made on locally available alluvial flint, these bifacial tools were introduced to the site as finished tools, as indicated by the presence of only two potential bifacial-thinning flakes. The more carefully made pieces were only slightly reworked, unlike the simpler pieces that were frequently resharpened. Four of these bifacial tools bear possible use-wear consistent with butchery and percussive activities, including one example that also exhibits traces on its base referable to percussion on a hard mineral material (Fig. 4) (M. Brenet and E. Claud).

3.4. Bout des Vergnes (Prigonrieux, Dordogne)

The Mousterian level of this open-air site, excavated in 2013 over 5200 m^2 under the direction of E. Ihuel and OSL dated to 50.3 ka ± 4.5, yielded 809 lithic artifacts, including 19 on metamorphic rocks. Raw materials are predominately local (95%), procured from directly available alluvial deposits. On-site flake production is almost entirely discoidal, the Levallois method being represented by only 17 large imported flakes, 8 eight of which are retouched. Sixty-eight cores were identified, 530 unworked flakes and 33 flake tools. Bifacial tools (2% of the industry, 33% of the tools) are represented by 15 bifaces and 2 bifacial side scrapers, accompanied by only two bifacial-thinning flakes. Made on flint from sources less than 5 km from the site, all of the bifacial tools were introduced as finished tools and correspond to three main morphotypes: bifaces with transverse oblique edge, lateral convergent edges, or lateral convex edges. While those manufactured from nodules are very well made, bifacial tools on flake blanks are much simpler; several are heavily resharpened while others are finished and devoid of use-wear. A preliminary use-wear analysis revealed 4 bifaces to most likely have been used for butchery. Seven others, including 2 with cutting wear on one edge, bear localized traces of percussion on a hard mineral material and/or wear indicating rubbing on an abrasive material (Fig. 5) (M. Brenet and E. Claud).

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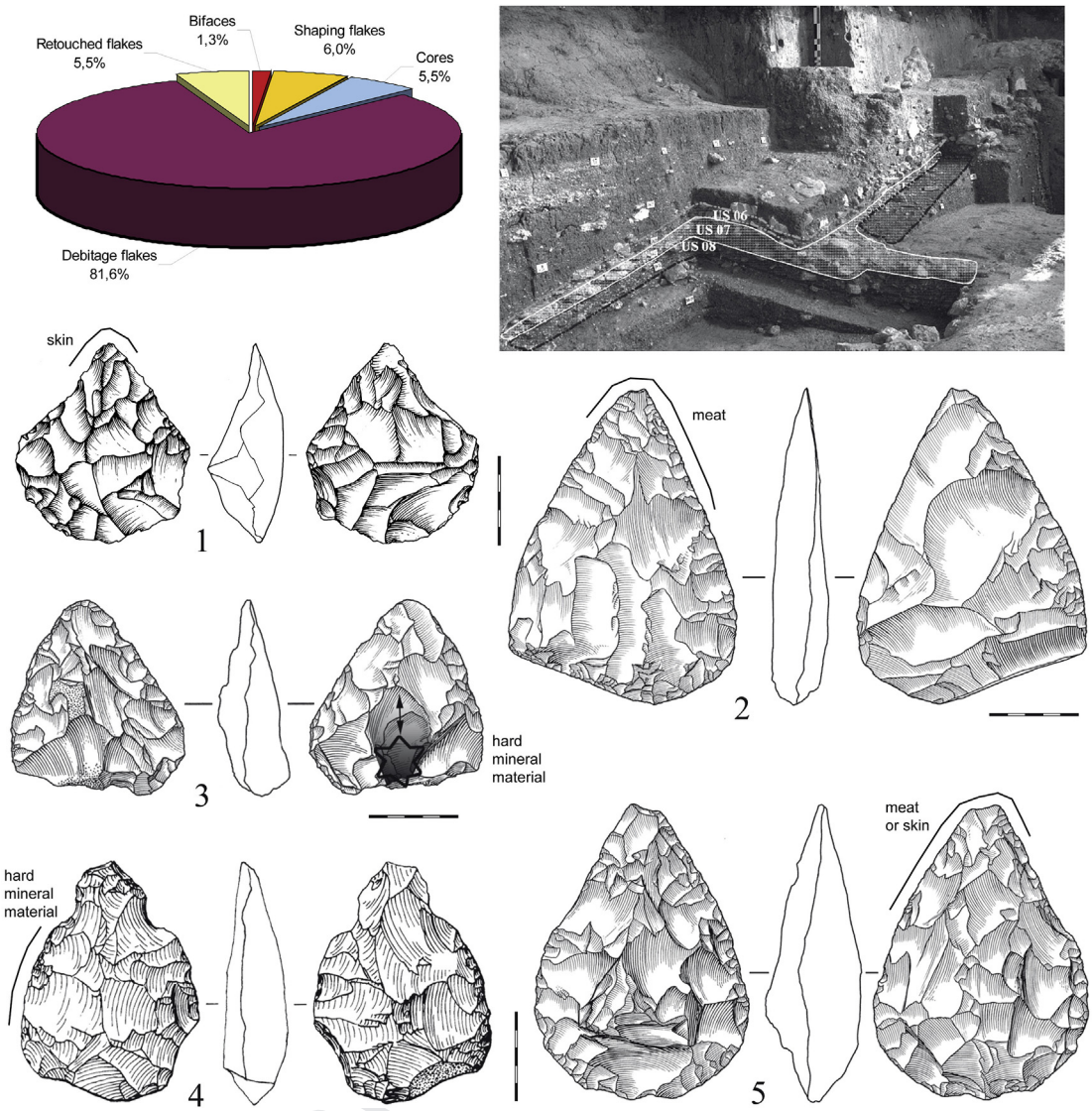

Fig. 2. Chez-Pinaud US-SW 06 and 07 (Jonzac, Charente-Maritime): relative proportions of bifacial-shaping and flaking in the industry, stratigraphic position of SU 6 and SU 7 (excavation 2004–2007). A recycled and heavily-reduced biface in non-local Turonian flint used for butchery (1), quartzitic sandstone biface used for butchery (2), recycled and reduced bifaces in local Senonian flint exhibiting use-wear consistent with percussion on a hard mineral material (3 and 4), biface in local Senonian flint used for butchery (5). Drawings F. Brenet (1), J.-F. Pasty (2, 3 and 5), J. Airvaux (4).

3.5. Combe Brune 2, level 2 (Creysse, Dordogne)

This very small lithic assemblage collected over a surface of less than 100 m^2 (excavation 2006–2007, M. Brenet dir.), lies between two stratigraphic units dated by OSL to 63.1 ± 6.5 ka and 39.2 ± 4.0 ka, respectively (Frouin et al., 2014). The bifacial tools were all made on local Maastrichtian flint flakes and comprise two very well made bifaces with lateral convex edges, a bifacial preform, a basal fragment of a piece broken by a bending force, and a bifacial scraper on an elongated flake with a cortical back. These artifacts were imported to the site and discarded at different stages of the manufacturing process. One biface bears use-wear consistent with butchery and it is possible that a third, unfinished example was used for direct percussion on wood (Fig. 6) (Claud, 2008). The most plausible interpretation of this small, imported bifacial tool assemblage is that the pieces were discarded following the non-specialized and expedient use of tools manufactured elsewhere in the anticipation of future needs (Brenet, 2011).

3.6. La Conne de Bergerac (Bergerac, Dordogne)

Given its chrono-stratigraphic position at the contact of a middle terrace of the Dordogne River, this level identified across 1700 m^2 can be attributed to the end of MIS 4. Excavated under the direction of M. Brenet and L. Bourguignon in 2002, the lithic assemblage comprises 752 artifacts: 733 in Maastrichtian or Santonian flint and 19 in quartz or quartzite procured from a local or nearby alluvial source. The assemblage is characterized by both Levallois and Discoid flaking, identified on 73 of 94 cores and 581 flakes, 33 of which are retouched. The 6 bifacial tools recovered from the site correspond to different morphotypes (bifaces with lateral convergent edges, convex edges or a transverse edge). These tools, three of which are made on flake blanks, were discovered outside of the flake production zones, in contrast to the 11 bifacial-thinning flakes found within concentrations. Three of the bifaces are finished and very carefully made. Use-wear analysis demonstrated two cordiform examples to have been used to cut soft animal materials, while a third, broken example

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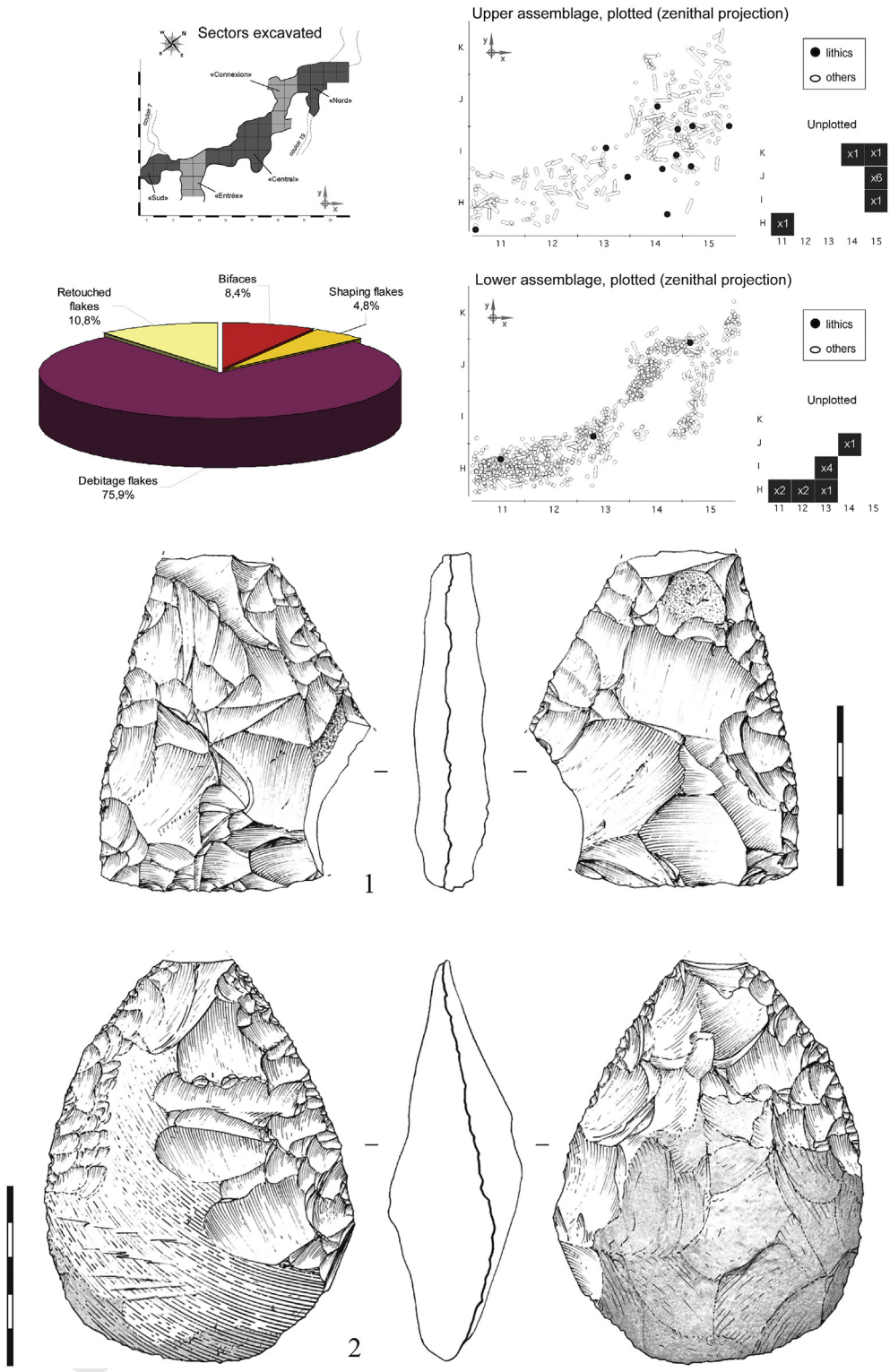

Fig. 3. La Chauverie (Ronsenac, Charente): distribution of tools in the lower and upper assemblages of the central sector (after Discamps et al., 2012), relative proportions of bifacial-shaping and flaking. Broken and recycled biface in non-local Turonian flint (1), biface on a cortical blank with a broken point in local Conacian flint (2). Drawings G. Devilder.

with a transverse edge may have been used to work wood by percussion. No clear use-wear was preserved on the simpler or unfinished tools (Fig. 7) (Claud, 2008; Claud et al., 2009; Claud, 2012).

3.7. La Graulet, level 3 (Bergerac, Dordogne)

In a stratigraphic position similar to that of Conne de Bergerac and probably residualised by post-depositional processes, this level is also attributable to the end of MIS 4. Excavated under the

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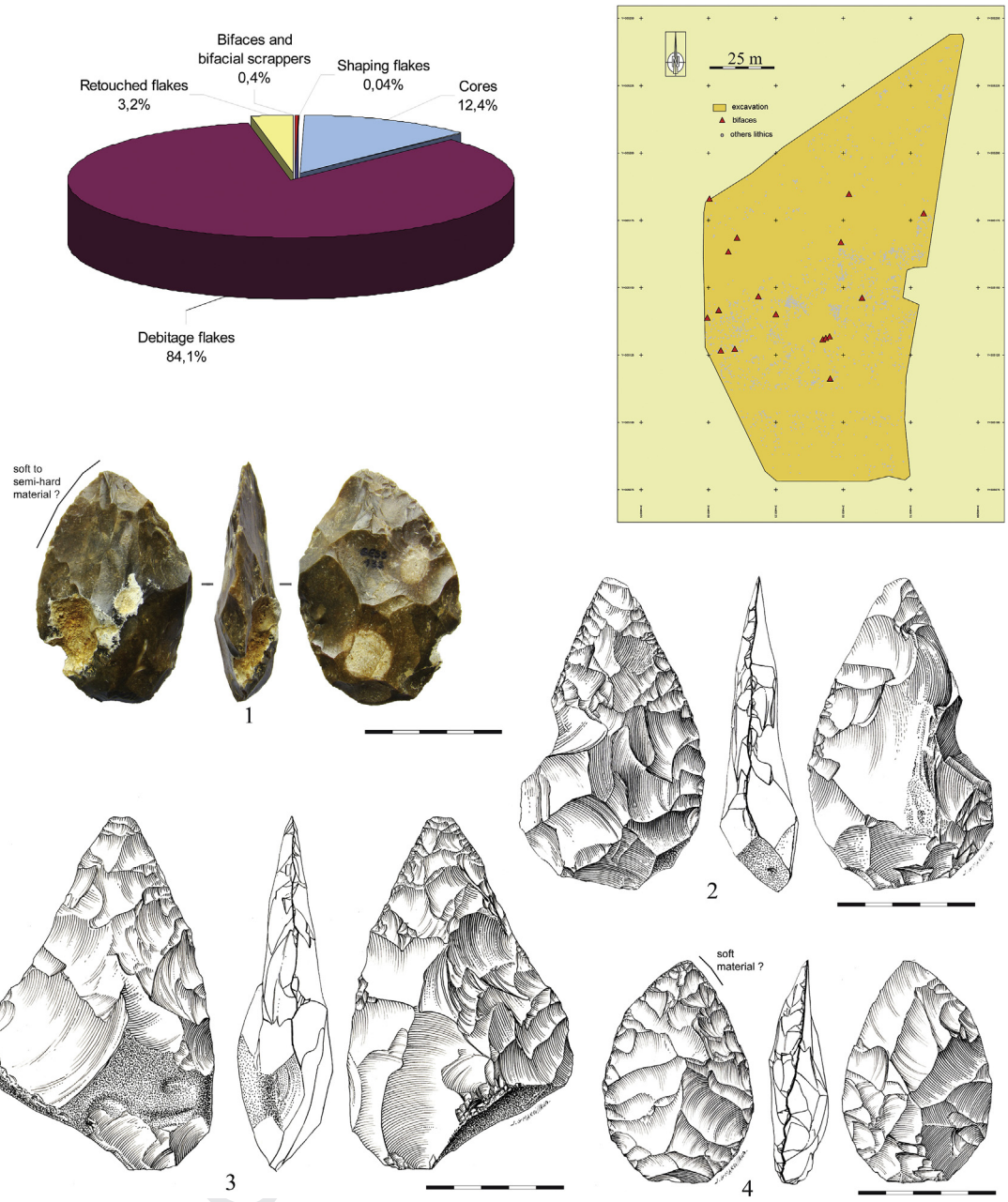

Fig. 4. Les Bessinaudes (Mussidan, Dordogne): relative proportions of bifacial-shaping and flake production in the assemblage, excavation plan showing the locations of the bifacial tools. Bifaces in local alluvial Senonian flint with lateral convex convergent edges and damage potentially linked to butchery (1 and 4), bifaces in local alluvial Senonian flint with straight, lateral convergent edges (2 and 3). Drawing J. G. Marcillaud, photo E. Claud, CAD A. Durante.

direction of M. Brenet and L. Bourguignon in 2003, a small lithic assemblage of 72 scattered flint and quartzite artifacts made on raw materials from local or nearby alluvial deposits or alterites were recovered from an 890 m^2 surface. The flint assemblage (n = 69) is composed of 6 Levallois and Discoid cores, 56 flakes, 2 of which are retouched, and 5 bifaces. These bifacial tools, three of which are made on flakes and three on flint pebbles, are generally oval-shaped with lateral convex edges and a relatively oblique transverse edge. The largest piece exhibits evidence for resharpening during use and is deformed in its apical portion. The other pieces are finished, carefully made, and were not resharpened. Two of these oval-shaped bifaces bear heavy wear on their points attributable to working wood with a percussive percussion (Fig. 8) (Claud, 2008; Claud et al., 2009; Claud, 2012).

3.8. Le Moustier (Saint Leon-sur-Vézère, Dordogne)

Early excavations (Peyrony, 1930) at this important rock shelter produced two layers with a bifacial component, layers G and H. However, it has recently been shown that the material assigned to layer H is not representative, both in terms of technology and fauna due to substantial recovery biases typical of early 20th century excavations (see Gravina and Discamp, 2015 for more details). Subsequently, layer H, originally assigned by Bordes to his type B variant of the MTA, has been reattributed to the Discoid-Denticulate Mousterian and layer G subdivided into a lower, primarily Levallois dominated assemblage (G1-G2) overlain by one (G3-G4) with a significant bifacial-shaping component based on an analysis of unbiased material recovered from a small test-pit in

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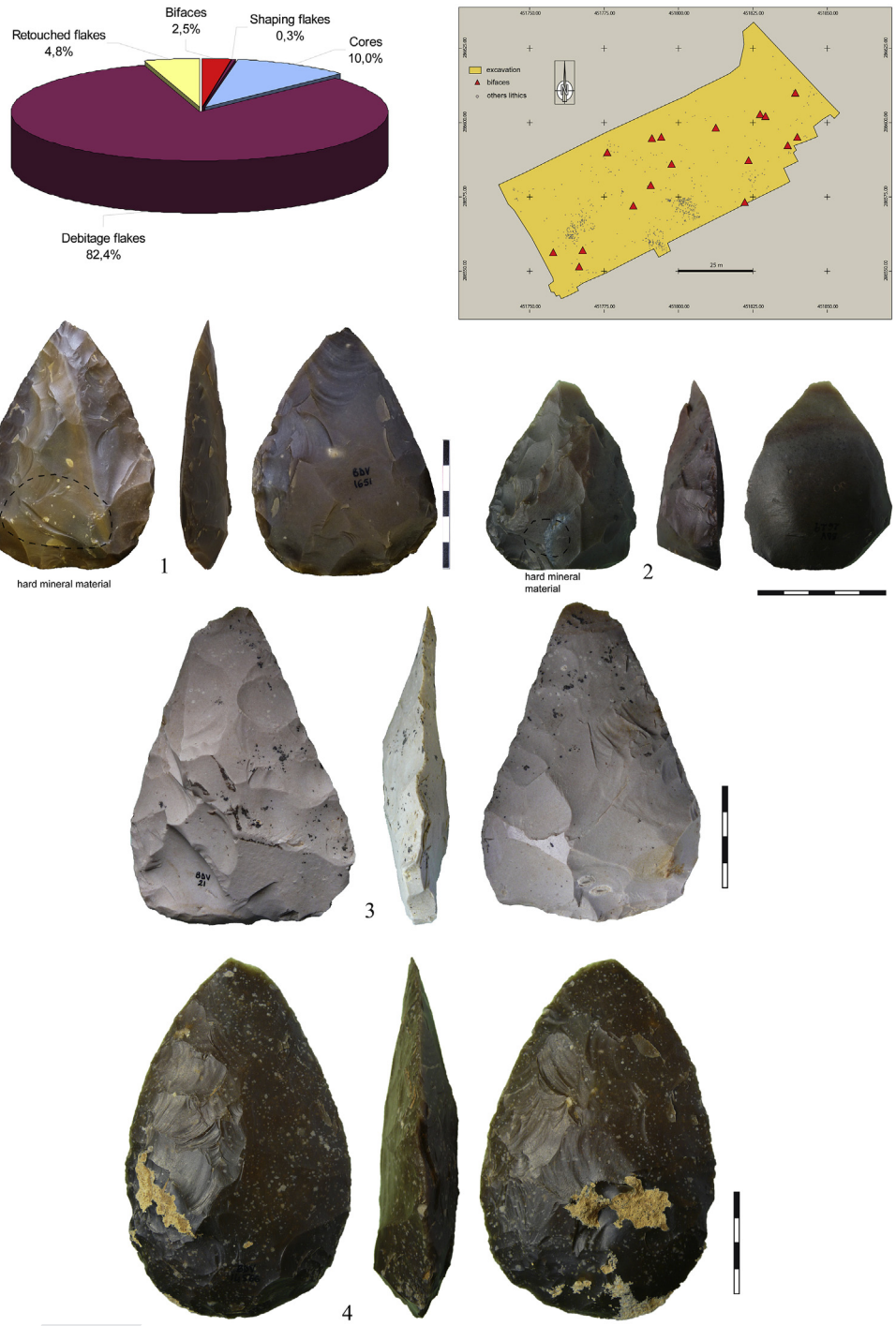

Fig. 5. Bout des Vergnes (Prigonrieux, Dordogne): relative proportions of bifacial-shaping and flake production in the assemblage, plan showing the locations of bifacial tools. Bifaces on Maastrichtian flint blanks, reduced by reworking and used for percussion on a mineral material (1 and 2), biface on Maastrichtian flint with lateral straight convergent edges and an apical oblique edge (3), biface in Maastrichtian flint with a lateral convex convergent edge exhibiting evidence for the cutting a soft to medium-hard material (4). Photos J. G. Marcillaud and E. Claud, CAD A. Durante.

1982 (Gravina and Discamp, 2015). In terms of the variable status of bifacial tools discussed for the other sites, the 16 bifaces recovered by Peyrony from his layer H are particularly instructive, as they provide genuine evidence of "recycling" as opposed to "re-use" or "re-sharpening". Eleven of the 16 bifaces recovered by Peyrony, as well as a recently identified example, all bear clear double patinas, whose nature indicates a passage from tools to cores (Fig. 9). Moreover, these "ex-bifaces" were exploited in a manner coherent with the nearly exclusive discoidal system typical of the material recovered in 1982 and correlated with Peyrony's layer H (Fig. 9).

3.9. Latrote (Saint-Gein, Landes)

Excavations in 2009 under the direction of S. Bernard-Guelle produced 2369 lithic artifacts spread across 4500 m^2 and dated by TL to 51.7 ± 7.3 ka. The assemblage is composed of various raw

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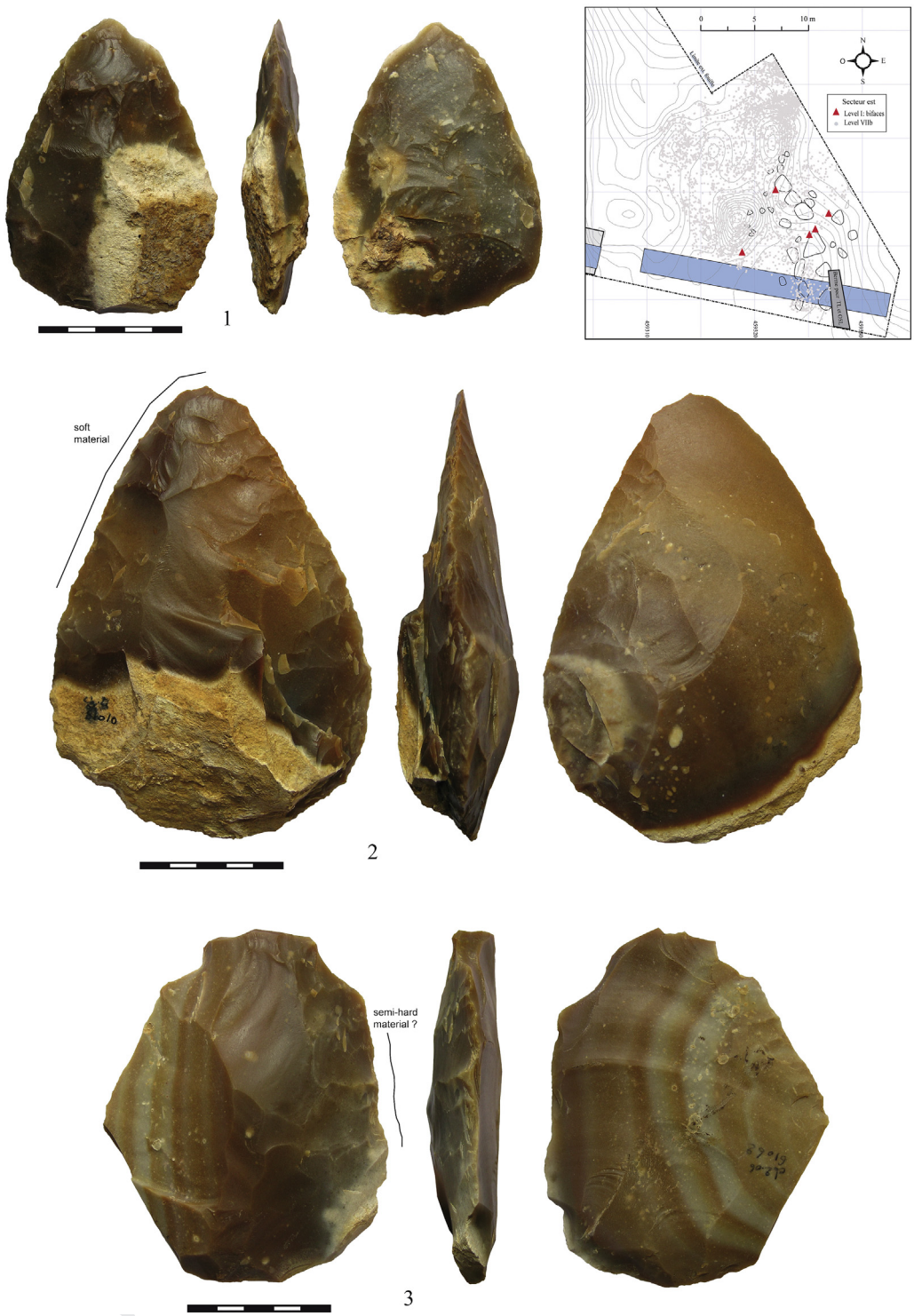

Fig. 6. Combe Brune 2 (Creysse, Dordogne): plan of the excavation showing the locations of the bifacial tools. Biface with lateral convex convergent edges on a local Maastrichtian flint flake, (1), biface with lateral convex convergent edges on a local Maastrichtian flint flake that was probably used for butchery to cut a soft material (2), biface roughout in local Maastrichtian flint probably used for percussion on wood (3). Drawings P. Rouzo, F. Brenet, CAD M. Brenet.

materials: metamorphic rocks from local alluvial sources (55%), Chalosse flint procured less than 20 km from the site (43%), and flint imported from distance of over 100 km (2%). Flake production, represented by 159 cores and 1217 flakes, is primarily discoidal, accompanied by a few Levallois cores and flakes. Seventeen bifacial tools were recovered from the site: 7 in flint, 7 in quartzite, and 3 quartzite cleavers. Bifaces with convergent convex edges and an unworked base dominate, whether in quartzite or flint, and, apart from a single example on Flysch flint from the Bayonne region, are all made on directly available raw materials or those from sources several dozen kilometers away (Bernard-Guelle et al., 2010).

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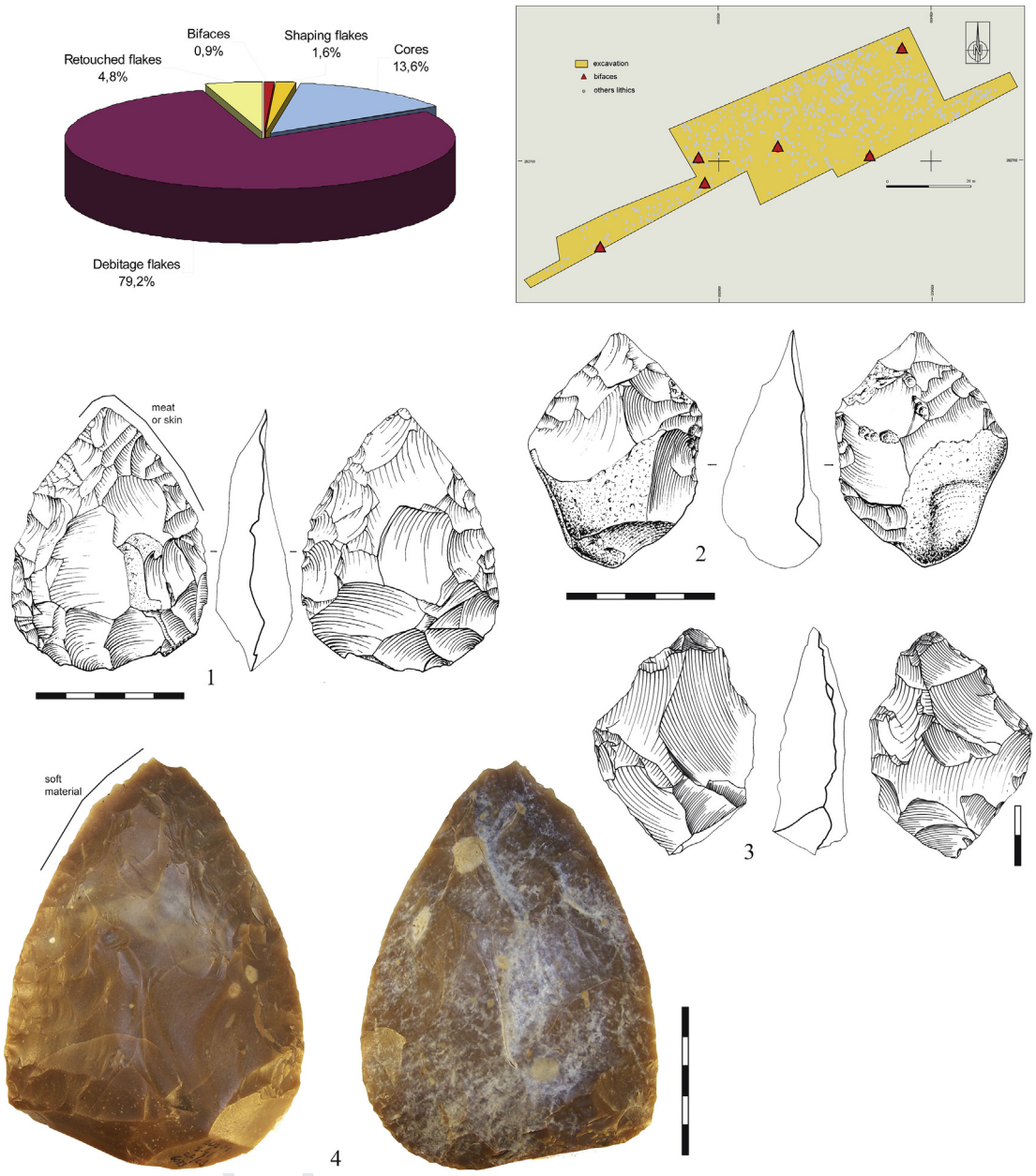

Fig. 7. La Conne de Bergerac (Bergerac, Dordogne): relative proportions of bifacial-shaping and flake production in the assemblage, plan of the excavation showing the locations of the bifacial tools. Biface in local Maastrichtian flint with lateral convex convergent edges, used for butchery to delicately cut meat and/or skin (1), biface with lateral, straight convergent edges in local alluvial Senonian flint, (2), irregular, heavily reduced biface on a Senonian flint flake with evidence for successive resharpening episodes (3), biface on local Maastrichtian flint with lateral convex convergent edges and used for butchery to delicately cut a soft material (4). Drawings P. Rouzo (1 and 2), F. Brenet (3), photo and CAD M. Brenet.

Several lines of evidence indicate these pieces to have had long use-lives. They were imported as finished tools and sometimes reworked on-site, as indicated by the 24 resharpening flakes recovered from the site as well as two pieces that were deformed following failed attempts to resharpen them by overshot transverse removals. The site appears to have been a location where bifacial tools used for butchery were imported and exported. One of the bifaces bears a percussion zone consistent with the working of a mineral material (Fig. 10) (Bernard-Guelle et al., 2010, 2014, Coudenneau *in*).

3.10. Le Prissé (Bayonne, Pyrénées Atlantiques)

Located on the Saint-Pierre-d'Irube plateau, this site open-air was excavated over a surface of 1300 m^2 in 2012 under the direction of D. Colonge. The lithic industry, dated by TL to 44.3 ± 1.9 ka, comprises 969 artifacts, most (90%) of which are on a locally available Flysch flint found 2 km north of the site around Ibardide. The remaining 10% of the exploited raw materials are derived from local or nearby alluvial sources.

The assemblage is composed of 66 cores and 705 flakes, 28 of which are retouched. The Discoid method is almost exclusive and is geared around the production of pseudo-Levallois points. Eight bifaces in Flysch flint, manufactured elsewhere and imported to the site, are accompanied by 6 ophite or quartzite cleavers (Colonge et al., 2014; Deschamps, 2014). Made on small slabs or flat blocks, the majority of the bifaces have lateral, convex, convergent edges and an unworked base. The limited number of bifacial-thinning flakes (n = 19) indicate these pieces were not manufactured on-site but were imported and

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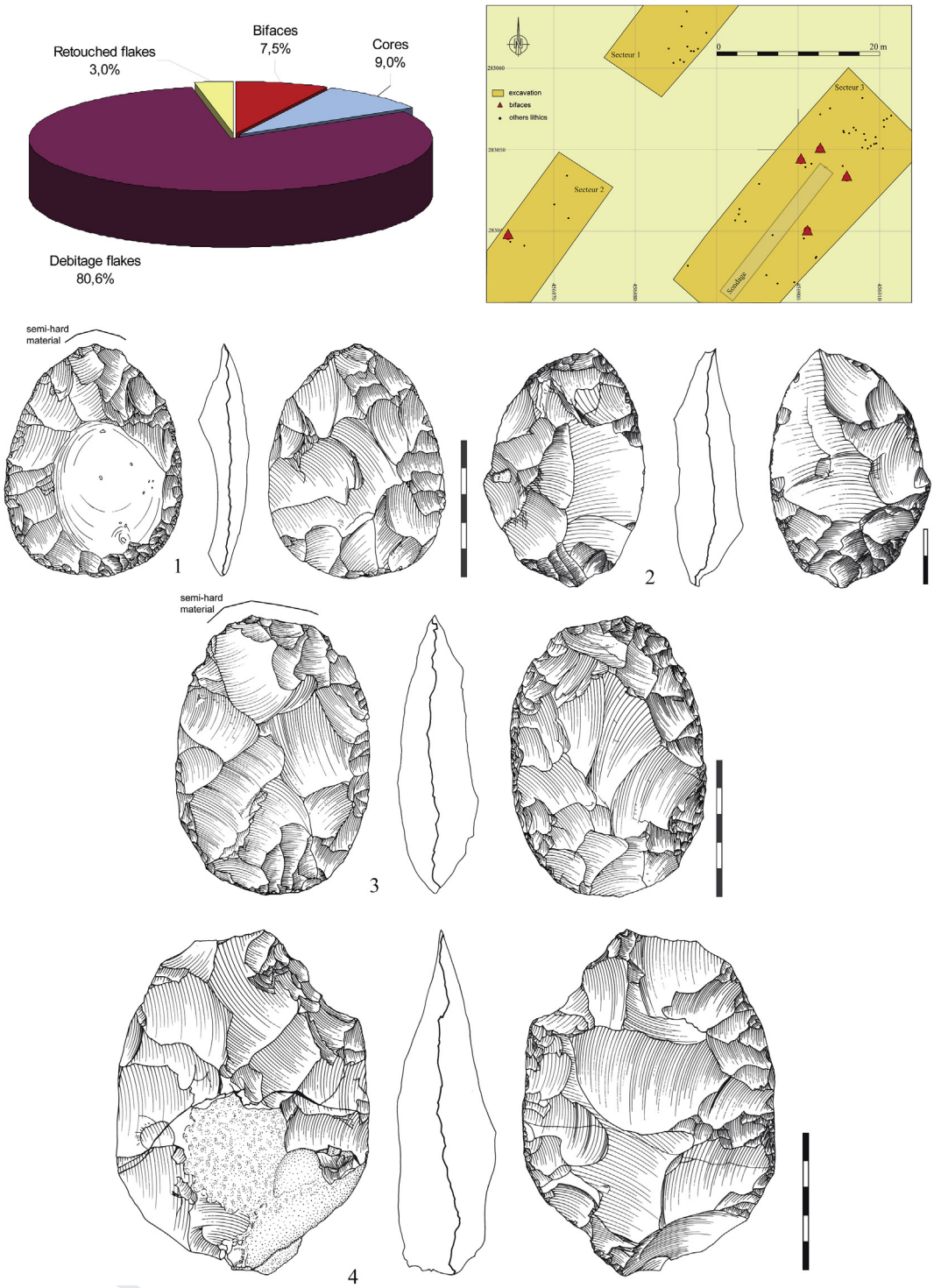

Fig. 8. La Graulet, level 3 (Bergerac, Dordogne): relative proportions of bifacial-shaping and flaking in the industry, excavation plan showing the locations of the bifacial tools. Biface on a local Maastrichtian flint flake with lateral convex convergent edges used in percussive motion to work a medium-hard material (wood?) (1), biface on a local Maastrichtian flint flake with lateral convex and convergent edges in its basal and apical portions (2), oval biface with lateral convex edges and an apical transverse edge in local Maastrichtian flint used in percussive motion to work wood (3), irregular oval biface on a local Maastrichtian flint flake with lateral convex edges and an apical oblique edge (4). Drawings F. Brenet, CAD M. Brenet.

subsequently used and/or resharpened. Several bifaces exhibit evidence of numerous resharpening episodes resulting in a significant transformation or reduction of their volume, cortical base and/or edges. Use-wear analysis revealed several examples to have been used for butchery, while flake tools, despite their fresh edges, preserve very little trace of use (Colonge et al., 2014) (Fig. 11).

3.11. Le Chemin de Jupiter (Bayonne, Pyrénées Atlantiques)

Located on the Saint-Pierre-d'Irube plateau some 500 m southwest of Le Prissé, excavations of a nearly 5000 m^2 surface under the direction of D. Colonge in 2012 yielded two Middle Paleolithic occupations, the most recent of which has been OSL dated to between

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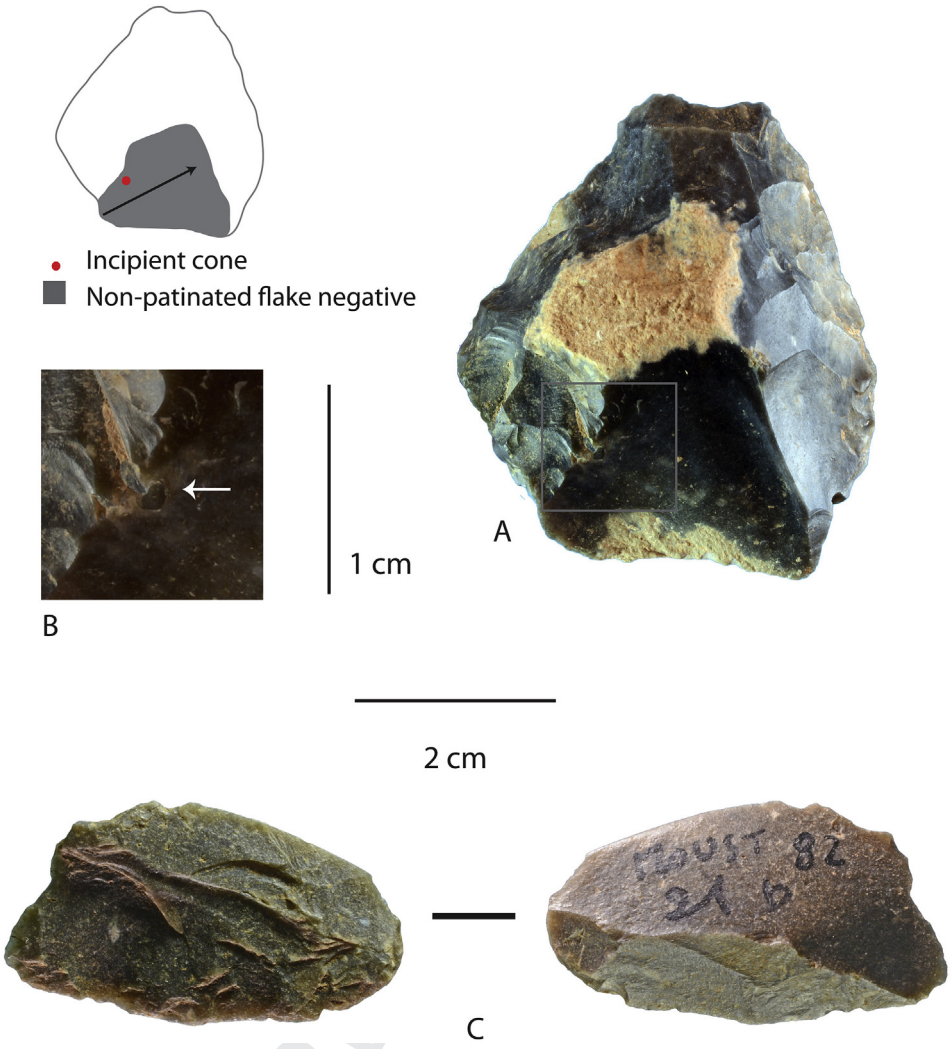

Fig. 9. Le Moustier, layer H: (a) biface (collection Peyrony) recycled as a core, note the clearly different surface aspect of the flake negative, an *éclat débordant*, and the incipient bulb (b) indicating an attempt to remove a second flake; (c) notch (collection Geneste and Chadelle) removed from a biface, note the clear difference in patinas between the ventral and dorsal surfaces.

46 ± 5 ka and 50 ± 3 ka. The lithic industry (n = 651) is made entirely on locally available Flysch flint found in the form of small slabs or nodules measuring 10–15 cm in length and identical to those exploited at Le Prissé. Flake production predominates (63 cores and 386 flakes), with discoidal debitage geared around the production of pseudo-Levallois points almost exclusively represented.

Bifacial tools are represented by 4 bifaces with lateral convergent edges and unworked bases made from thin volumes, accompanied by only 26 bifacial-shaping flakes, which seem to correspond to resharpening rather than on-site production. Two bifaces display significant deformations resulting from attempts to resharpen the piece by overshot flake removals (Fig. 12). The three quartzite cleavers were imported to the site as finished tools (Deschamps, 2014). Use-wear analysis on the imported bifacial tools (Fig. 12) revealed undetermined wear (probably referable to cutting and percussion).

3.12. Le Basté (Saint-Pierre-d'Irube, Pyrénées atlantiques)

Excavated in the late 1960s, the 30 m^2 Middle Paleolithic level of Le Basté (Chauchat and Thibault, 1968), although not dated directly, can be securely attributed to MIS 3 given its stratigraphic position directly beneath a Châtelperronian occupation as well as chrono-stratigraphic correlations with the sequences of Le Prissé and Le Chemin de Jupiter located only a few hundred meters away (Deschamps, 2014; Colonge et al., 20[illegible]). The small but homogeneous assemblage comprises 379 lithic artifacts, 90% of which are made on a local flint procured from the same primary sources as those exploited at Le Prissé and Le Chemin de Jupiter. The remaining 10% of the pieces are made on local or nearby alluvial materials. Flake production (68% of the assemblage) is not very specific, represented by 9 centripetal cores and 217 flakes, 30 of which are retouched. Bifacial-shaping is represented by 17 bifacial tools with predominately lateral, convex, convergent edges and an unworked base alongside slightly more than 100 bifacial-thinning flakes. The majority of these pieces were manufactured from small flint slabs or flat blocks. Several heavily resharpened and sometimes deformed bifaces were abandoned at the end of their use-life.

Unlike the two previous sites, Le Basté seems to be a workshop site, perhaps centered around the use of bifacial tools. One biface, resharpened by the detachment of a transverse overshot flake removing both active edges of the piece, and the conjoining of two flakes attributed to this resharpening method, raise the question, as at the sites of Latrote and Le Chemin de Jupiter, of the mastery of this complex technique of resharpening bifacial tool edges (Fig. 13).

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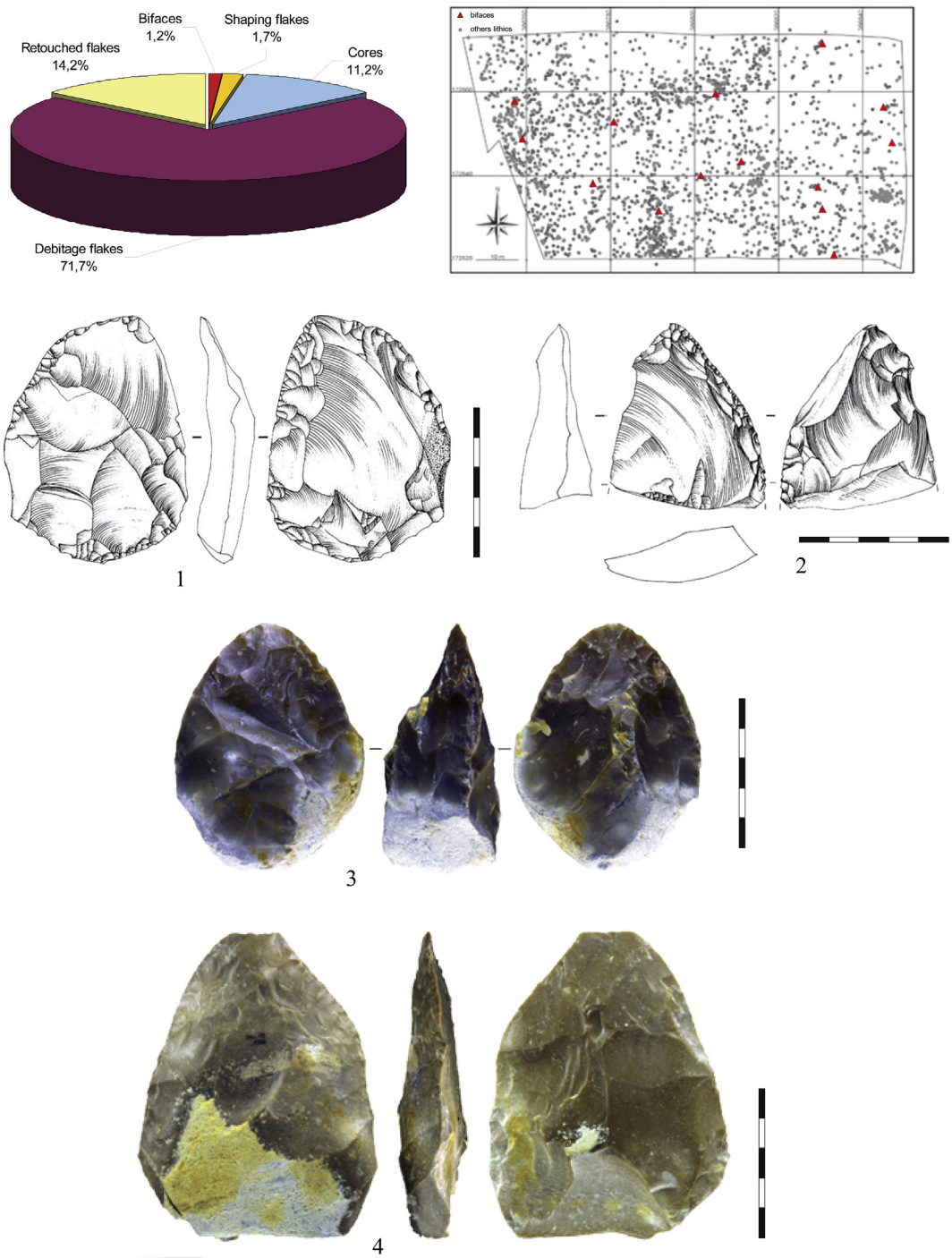

Fig. 10. Latrote (Saint-Gein, Landes): relative proportions of bifacial-shaping and flake production in the assemblage, excavation plan showing the locations of the bifacial tools. Biface in local Chalosse flint with lateral convergent edges and an apical oblique edge resharpened by a transverse overshot removal (1), transverse overshot resharpening flake (2), biface in Flysch flint from the Bayonne region with an unworked base and lateral convex convergent edges used for light butchery (3), biface in local alluvial Chalosse flint with an unworked base and lateral convergent edges and a broken, apical oblique edge, used for light butchery (4). (Drawing R. Picavet, photos M. Rémicourt, CAD M. Deschamps, plan of artifact distribution S. Bernard-Guelle).

4. Comparison of the assemblages studied

4.1. Dominant flake production

Apart from Combe Brune 2, flake production is best represented at all of the studied sites, representing between 67 and 98% of the assemblages (Table 1 and Fig. 14), and was most often carried out on-site using directly available raw materials or those procured from sources less than 5 km away. Only a few flint flakes, including retouched tools, transported from nearby or more distant sources can be connected to earlier production phases. At Les Bessinaudes and Bout des Vergnes, and to a lesser extent, La Conne de Bergerac, a significant proportion of the assemblage was exported. The high diversity of blanks reflects the different flaking

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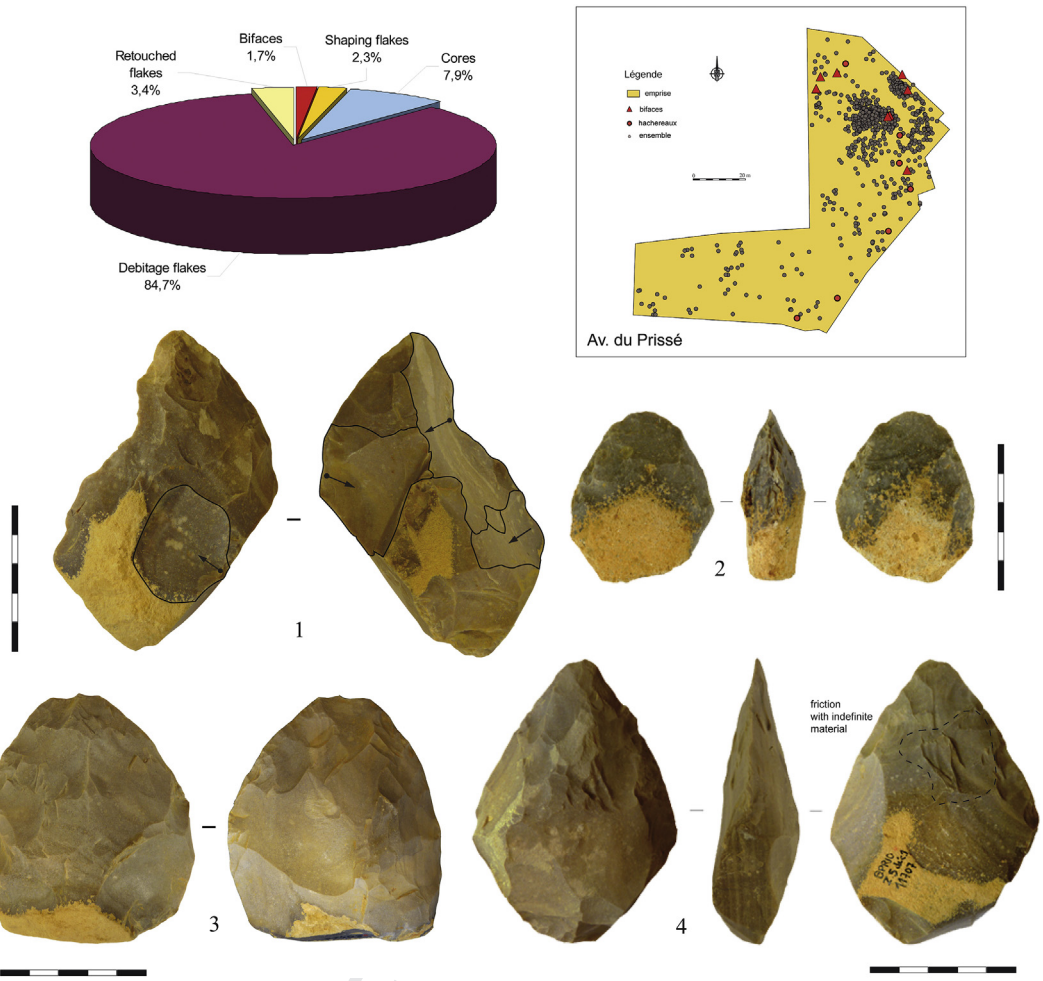

Fig. 11. Le Prissé (Bayonne, Pyrénées Atlantiques): relative proportions of bifacial-shaping and flake production in the assemblage, excavation plan showing the locations of the bifacial tools. Biface in local Flysch flint with a partially unworked base, and a lateral edge deformed by one or more resharpening episodes (1), bifaces in local Flysch flint with unworked bases and lateral convex convergent edges reduced by successive resharpening episodes (2 and 3), biface in local Flysch flint with an unworked base and lateral, straight, convergent edges bearing an indeterminate use-wear on one surface. (Photos and CAD M. Deschamps).

methods employed: flakes with peripheral edges for the Levallois method, thick sub-triangular flakes for the Discoid method, or elongated flakes produced by the limited number of documented laminar reduction sequences. These different methods are at times nearly exclusive, such as at Bout des Vergnes, Le Prissé and Le Chemin de Jupiter (Discoid) or Combe Brune 1 (Levallois), another open-air site in the Dordogne region dated to 42.1 ka (Bourguignon et al., 2006; Vieillevigne et al., 2008). At other sites, these methods coexist, as at Les Bessinaudes, where the Levallois, Discoid and laminar methods were used, La Conne de Bergerac, where the Levallois and Discoid methods involved different types of flint, and Latrote, where the dominant Discoid method is associated with a limited number of Levallois cores. Flake tools, whether manufactured on-site or imported, were most often used on-site to butcher species that, apart from Chez Pinaud in the Charante, remain difficult to identify due to the lack of organic remains on preserved on open-air sites due to the lack of organic remains.

4.2. Relationship between flake production and bifacial-shaping

Flake production is associated with bifacial-shaping at several of the studied sites, and at times produced large thick blanks that were subsequently transformed into bifacial tools with asymmetric volumes. The majority of the bifacially-worked flake blanks do not appear to result from complex flake reduction sequences carried out on-site. Instead, they were imported to the site and subsequently used and sometimes resharpened. Occasionally manufactured on large, only slightly predetermined initial preparation flakes, either the blank was only partially flaked or both surfaces of the blank were shaped, with modifications concerning primarily the prehensile zones and active areas. The importation of finished bifacial tools made on flakes is most evident with the Dordogne sites of Bout des Vergnes, Combe Brune 2, and La Graulet. This is particularly the case with bifacial scrapers. The situation is different at Chez Pinaud in the Charente, where several bifaces on flakes were manufactured on-site, although it is impossible to determine whether the blanks concerned were imported or produced at the site.

In techno-economic terms, the flake cleavers from the three sites in the Basque region appear very similar to those from the three sites in the Dordogne, all being imported as finished tools. Only the prehensile areas, often the proximal and lateral portions of large flake blanks, were retouched (Tixier, 1956; Mourre, 2003), with the active, distal transverse edge remaining unmodified. This pattern suggests both relatively short use-lives of these tools made on metamorphic rocks and different functions compared to flint bifaces with convergent edges (Claud et al., 2015).

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Table 1
Technological composition of the lithic assemblages studied. Comparable data for Le Moustier is currently unavailable due to the nature and collection methods of the early excavations at the site (see Gravina and Discamp, 2015 for more details).

Site	Type	Surface (m^2)	Lithic artifacts	Cores	Non-retouched flakes	Flake tools	Bifacial tools	Bifacial-thinning flakes
Chez Pinaud	Rock shelter	10	2811	154	2295	156	36 bifaces	170
La Chauverie	Rock shelter	30	99	0	63	9	7 bifaces	4
Bessinaudes	Open-air	9500	6192	599	4071	153	17 bifaces	2
Bout des Vergnes	Open-air	5200	809	68	561	33	15 bifaces 2 bifacial scrapers	2
Combe Brune 2	Open-air	100	5				4 bifaces 1 bifacial scraper	
La Conne de Bergerac	Open-air	1700	752	94	548	33	6 bifaces	11
La Graulet	Open-air	890	72	6	54	2	5 bifaces	0
Latrote	Open-air	4900	2369	159	1217	201	14 bifaces 3 cleavers	24
Le Prissé	Open-air	1300	969	66	705	28	8 bifaces 6 cleavers	19
Chemin de Jupiter	Open-air	5000	651	63	386	19	4 bifaces 3 cleavers	26
Le Basté	Open-air	35	369	9	217	30	17 bifaces	106

Moreover, the possibility that several bifaces functioned as both tools and cores capable of providing potential tool blanks cannot be excluded. With that said, the modification and/or use of bifacial-shaping flakes remains very rare and appears opportunistic, especially in light of the fact that most of the retouched tools are made on blanks from *chaînes opératoires* dedicated to flake production.

4.3. Factors underlying the variability of bifacial tools

Our results suggest the bifacial tools documented from the 11 sites considered here to present as much diversity in their manufacture method as they do consistencies in their function and economic organization (Table 2). The initial diversity of these tools is connected primarily to the accessibility, abundance, and diverse properties of the lithic raw materials employed, as well as the form of the volumes transformed (e.g. blocks, small slabs, and flakes). Particular raw materials, both in terms of their abundance and flaking quality, were sought out and preferred for biface production, such as Maastrichtian and Flysch flint available, respectively, in and around the Bergerac region and Basque Country. Moreover, flake cleavers from both the Landes region and further south in the Basque Country were systematically made on quartzite or ophite from alluvial sources.

While easily accessible raw material sources were most commonly exploited for flake production, as well as the large majority of bifacial tools, these materials were sometimes transported over long distances, as demonstrated by bifaces in Turonian flint manufactured in anticipation of future needs and

Table 2
Summary of the function, skill level, and production phases documented for the sites studied.

Site	N of bifacial tools	Manufactured on-site	Imported bifaces	Technical skill	Biface locations	Biface uses	Organization	Site function
Chez Pinaud	48	yes	yes	variable	Undetermined	Butchery Wood working? Mineral percussion	Flake manufacture/use Biface import/manufacture/use	Mixed activities
La Chauverie	7	no	yes	variable	Taphonomic dispersion	Not recorded	Flake import/use Biface import/use/maintenance	Brief use
Bessinaudes	17	no	yes	variable	Periphery of lithic manufacturing zones	Possible butchery (cutting/percussion) Mineral percussion	Flake manufacture/use/export Biface import/use	Mixed activities
Bout des Vergnes	17	no	yes	variable	Periphery of lithic manufacturing zones	Butchery Mineral percussion Mineral rubbing?	Flake manufacture/use/export Biface import/use	Mixed activities
Combe Brune 2	5	no	yes	variable	Dispersed	Butchery	Biface import/use	Brief use
La Conne de Bergerac	6	no	yes	variable	Periphery of lithic manufacturing zones	Butchery Wood working?	Flake manufacture/use/export Biface import/use	Mixed activities
La Graulet	5	no	yes	variable	Dispersed	Wood working	Flake manufacture Biface import/use	Undetermined
Latrote	17	no	yes	variable	Dispersed	Butchery Mineral percussion	Flake manufacture Biface import/use/maintenance	Mixed activities
Le Prissé	14	no	yes	variable	Periphery of lithic manufacturing zones	Butchery Mineral percussion Rubbing (mineral?)	Flake manufacture/use/export Biface import/use/maintenance	Mixed activities
Chemin de Jupiter	7	no	yes	variable	Periphery of lithic manufacturing zones	Possible butchery (cutting/percussion) Mineral rubbing?	Flake manufacture/use/export Biface import/use/maintenance	Mixed activities
Le Basté	17	yes	yes	variable	Dispersed	Possible butchery (study in progress)	Flake manufact./import/transformation Biface import/manufact./use/maintain	Mixed activities

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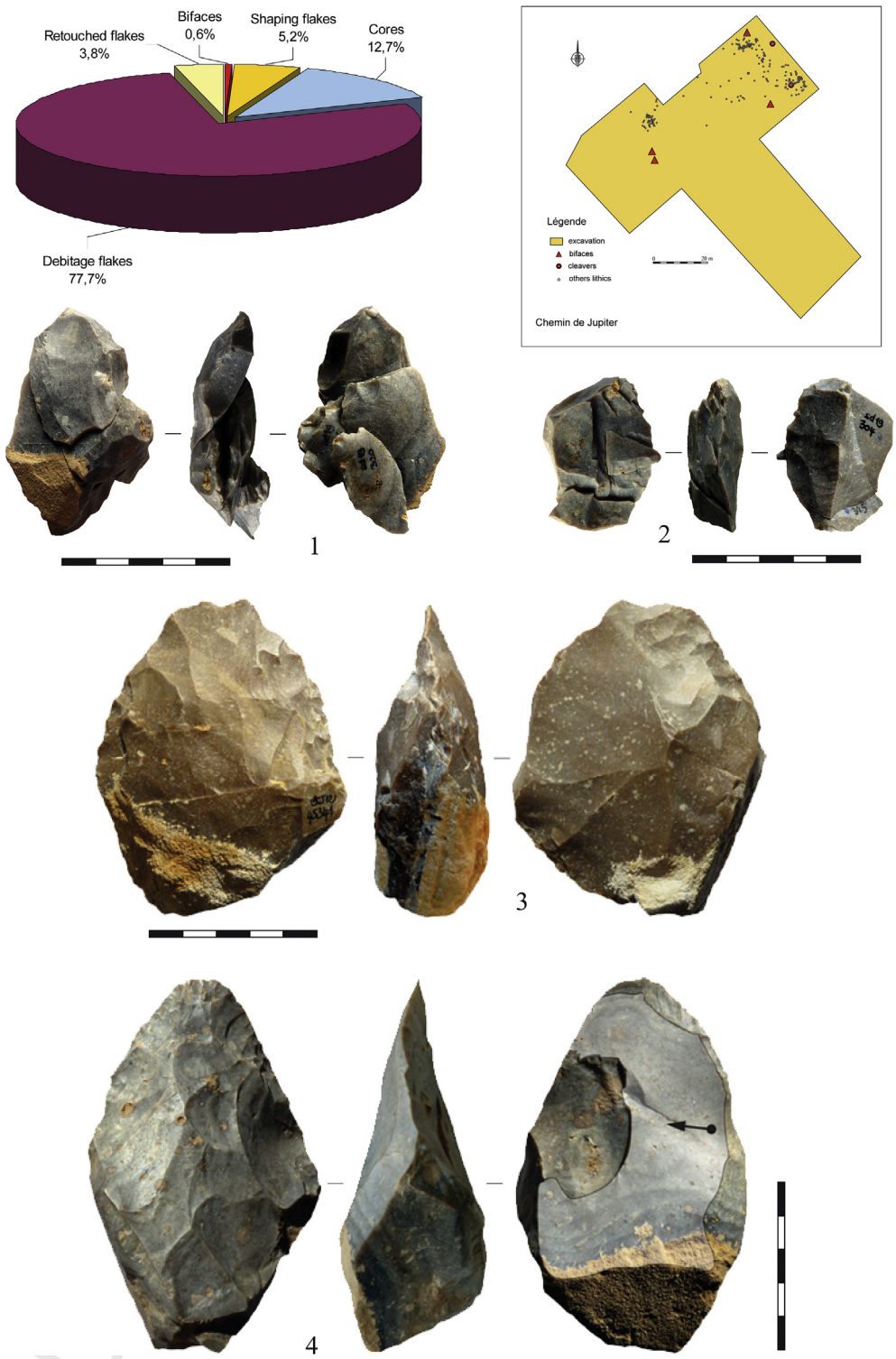

Fig. 12. Le Chemin de Jupiter (Bayonne, Pyrénées atlantiques): relative proportions of bifacial-shaping and flake production, excavation plan showing the locations of the bifacial tools. Conjoined bifacial-shaping flakes (1), conjoin of an edge maintenance flake onto a biface fragment (2), biface with an unworked base, lateral convex edges and an apical transverse edge in local Flysch flint, (3), biface with an unworked base and lateral, straight, convex edges in local Flysch flint, (4) (Photos and CAD M. Deschamps).

transported at least twenty kilometers to the south to Chez Pinaud or La Chauverie in the Charente, or those made from Flysch flint, transported more than 70 km to the north-east to Latrote in the Landes region. At Le Moustier (Soressi, 2002; Gravina and Discamps, 2015) and Pech de l'Azé I (Soressi, 2002; Soressi et al., 2008), this circulation of bifaces made from non-local raw materials is evident in the presence of bifacial-thinning flakes in Bergeracois flint from sources found at least 35 km from the site.

The various biface morphotypes present at these sites, the most common being those with lateral convergent edges, convergent edges and an apical oblique edge, and examples with an apical

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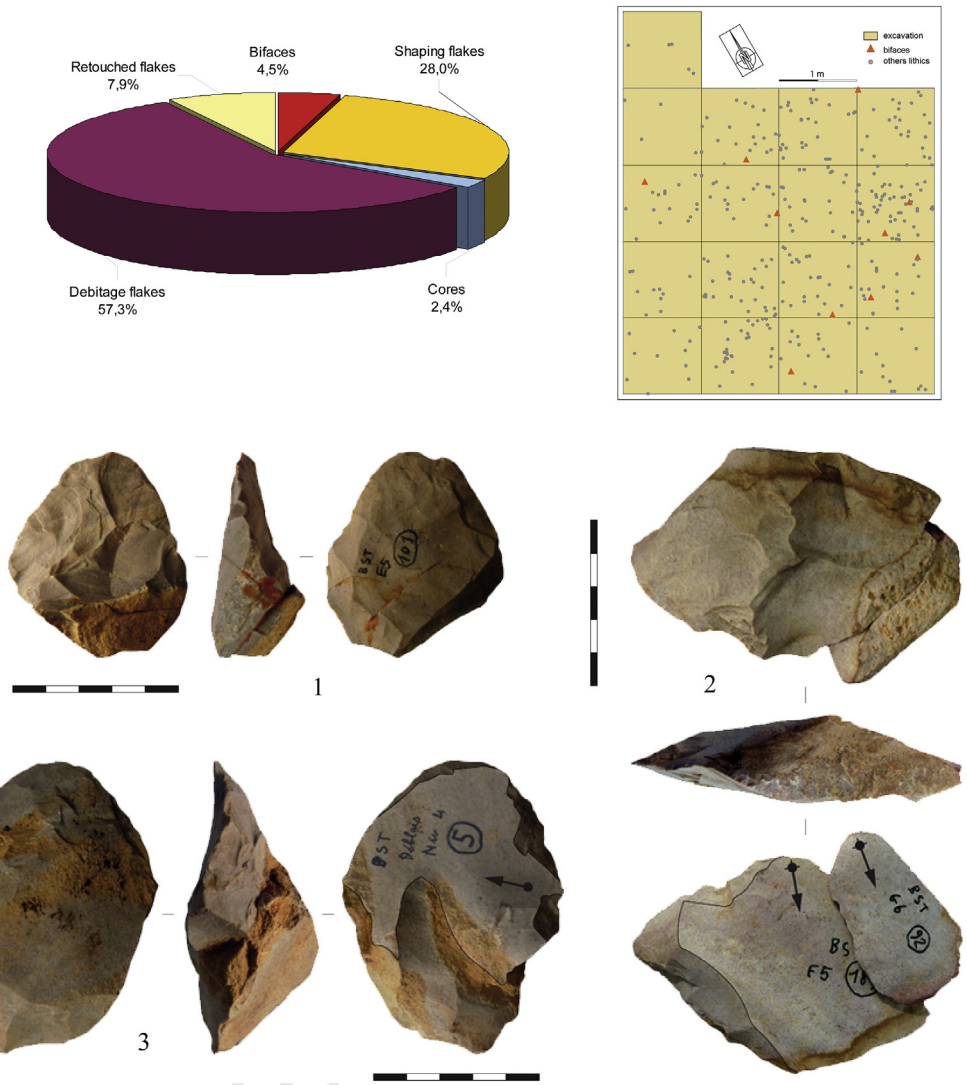

Fig. 13. Le Basté (Saint-Pierre-d'Irube, Pyrénées Atlantiques): relative proportions of bifacial-shaping and flake production in the assemblage, excavation plan showing the locations of bifacial tools. Biface in local Flysch flint with an unworked base and heavily reduced by successive resharpening episodes(1), conjoin of overshot resharpening flakes (2), biface in local Flysch flint with an unworked base and lateral convex convergent edges, heavily reduced by successive resharpening events, and with a transverse overshot flake scar (3). (photos and CAD M. Deschamps).

transverse edge, attest to the functional diversity of these tools. The particular configuration of the prehensile areas and the active edges depends on the intensity and duration of the activities for which they were used as well as the physical properties of the materials worked.

This diversity may be linked to variability in the technical skills and know-how of the artisans. Several bifacial tools, often made on fine-grained, homogeneous non-local flint blanks flint, stand out in the assemblages and attest to a high degree of technical competence and investment. This is the case with bifaces displaying a pronounced axial symmetry and very regular edges that go well beyond what is required for the activities for which they were used (Chez Pinaud, Fig. 2, n°2; Bout des Vergnes, Fig. 5, n°4; La Conne de Bergerac, Fig. 7, n°4). For example, a finely made cordiform biface with lateral convex convergent edges at La Conne de Bergerac was used to carefully cut a soft material in a very similar manner to that documented for a less well made biface of the same morphotype (Fig. 7, n°4 and n°1).

In other cases, most of the bifaces made on locally available flint are simpler and often repeatedly resharpened, reducing and sometimes modifying their initial volume. It appears that they were intensively used in nearby locations, or a single location, where they were discarded. While several examples of these common (expedient?) tools, reworked and reduced during their use-lives, are present at the sites in the Landes region and Basque Country (Fig. 10, n°3; Fig. 11, n°1 et 2, Fig. 13, n°1) other bifaces were reworked following a rather complex process of intentionally detaching overshot flakes (Fig. 10, n°1 et 2; Fig. 12, n°4; Fig. 13, n°2 et 3). At Bout des Vergnes in Dordogne, the volumetric equilibrium of several intensively reduced bifaces made from local flint remained constant or was only slightly modified by successive resharpening episodes (intentional allometry?) (Fig. 5, n°1 et 2).

Moreover, bifaces on flint from distant sources were sometimes deformed by attempts to repair the edge or were broken. This is the case with several bifaces in non-local flint from Chez Pinaud and La Chauverie in Charente. Whether carefully made or not, the manufacture, use and maintenance/reduction of these tools could have occurred in different places in the course of movements of human groups from sources of raw materials to the sites at which they were discovered.

Finally, the reuse of several bifacial tools may underlie their diversity, such as at Chez Pinaud, where at least 11 pieces with

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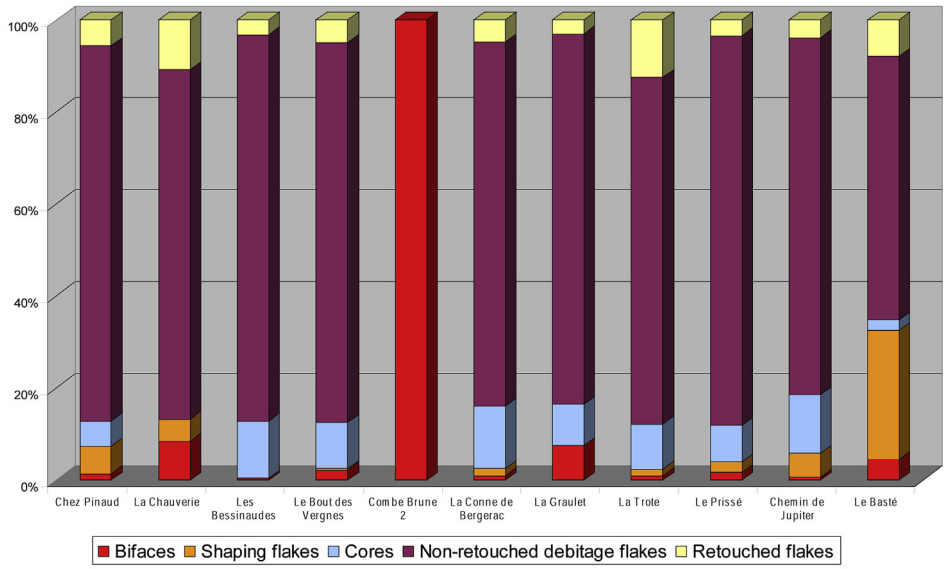

Fig. 14. Comparison of the proportions of bifacial-shaping and flaking on flint within the 12 assemblages studied. Comparable data for Le Moustier is currently unavailable due to the nature and collection methods of the early excavations at the site (see Gravina and Discamp, 2015 for more details).

traces of impacts on a hard mineral material may suggest their use as retouchers. A limited number of bifaces from other sites exhibit very localized percussion traces, although it remains to be determined if these tools were used for active or passive percussion (hammer or billet), and whether they represent reuse or a complementary function to the sharp edges used for butchery. The example of Le Moustier is particularly interesting in this respect as it clearly demonstrates the recycling rather than reuse of predictable sources of raw material (bifaces) from an underlying level for the production of flakes.

4.4. The function and role of bifaces

Within this inter-and intra-site complexity, can we distinguish features shared among these bifacial tools? If so, what are these features? Are there perceptible similarities in the function and role of biface morphotypes or particular bifacial pieces that would enable us to distinguish them from flaked tools?

Intrinsic similarities between the bifacial component of lithic assemblages are above all related to their technical concepts. Following the selection of available raw materials according to both manufacture objectives and intended uses and independent of the skills and percussion techniques employed, the initial stages of bifacial-shaping always proceed along the same lines. The bifacial volume of the tool is created through the successive removal of flakes from a peripheral ridge separating the two, more or less convex, flat or irregular surfaces of the blank. This initial preparation phase can be replaced by the production of a flake blank with a preexisting bifacial volume.

After this initial preparation of the bifacial form, shaping varies according to the morphological and functional specificities of the different biface morphotypes and the association, position and specific features of future prehensile and active areas. The shapes and cross-sections of the prehensile areas of the base of these pieces also vary, being unworked or unusable, sometimes with a back that extends onto an edge. The sharp active areas vary in the numerous possible arrangements, convergences, shapes and cross-sections of the two edges and point.

Some of the bifaces in the studied assemblages, including the simplest ones, are common tools that were often used, resharpened and reduced. These “domestic tools” in the same sense as most of the common flake tools, were manufactured and used for frequent tasks and share a technical longevity limited in time and space. Their mobility would be confined to the trajectory between a nearby production location and the site of their final use and discard. They were manufactured, used and resharpened when necessary, and subsequently discarded after being no longer functional or following a final recycling episode. The technical capacities and know-how evident in their production and use were likely shared by different members of the group and collectively transmitted without selection. These tools may have been for collective use, passed from person to person until exhausted and abandoned (one task = one biface), or were an element of a personal tool-kit (one individual = one biface), whose owner was capable of producing and transforming it according their needs (Fig. 15).

The scenario could be different for the very carefully made bifaces, which are less frequent in assemblages, and even for some preforms. These pieces demonstrate certain individuals to possess technical knowledge and skills that distinguished them from the rest of the group. The bifacial tools these individuals were capable of producing stand out against the more frequently shaped tools both in terms of their technical and “aesthetic” qualities, including their regularity and axial symmetry. We must therefore consider the possible implications and significance of these distinctive tools, which can be considered as behavioral and social markers insomuch as they may represent the distribution of manufacturing tasks amongst the group, or different degrees of technical competences amongst individuals of a single social entity. Episodes of their strict functional use would be brief, often for working softer materials (butchery?), thus increasing their technical longevity. The inter-site mobility attested by many of these pieces in non-local flint would also indicate their role was not simply functional, but perhaps also “symbolic” since they were frequently displaced and infrequently, if ever, used.

Building on previous research and to better understand the cultural and social significance of the different types of bifacial tools, other domains (volumetric allometry, mental templates, social learning, mimetic culture, technological meme, individual human idiosyncrasy, artifact individualization, symbolic behavior, teaching-learning, etc.), in addition to technological aspects, must

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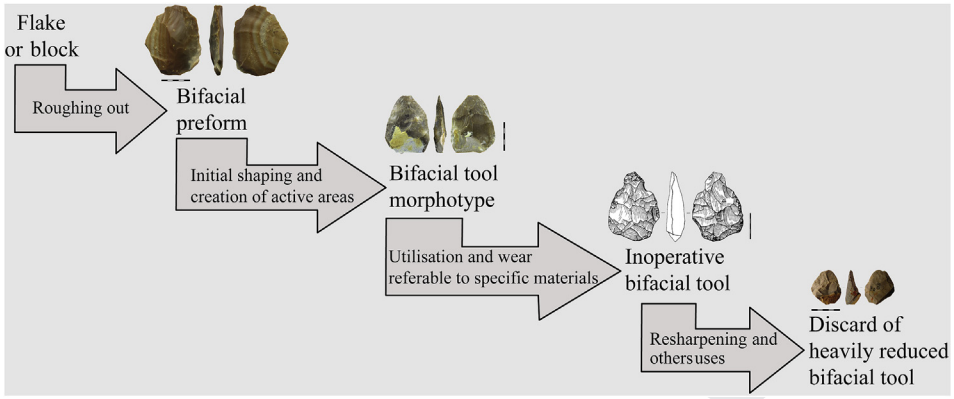

Fig. 15. Successive production/utilisation phases of common bifacial tools. They were often used on different materials, resharpened and reduced before abandonment and attest a technical longevity limited in time and space. Others carefully made bifaces were briefly used, often for working softer materials, thus increasing their technical longevity.

be addressed (e.g. Gowlet, 1984; Wenban-Smith, 1989; Kuhn, 1992; Gibson, 1993; Mithen, 1994; Wynn, 1995; Gamble, 1998; Blackmore, 1999; McPherron, 2000; Ashton and White, 2003; Nowell et al., 2003; Le Tensorer, 2006; Boëda, 2013; d'Errico and Banks, 2015). The "biface" should therefore be considered beyond its use as a tool that efficiently enhances the functioning of the human hand. It can also be seen as a possible identity marker (e.g. status, gender or age) for one or more individuals, or as a collective object marking a significant place or subsistence activity important to the group, a tool with a particular aesthetic dimension, a highly mobile tool apt to be exchanged, a symbol of the skill of the knapper responsible for their production, or as a material support to aid in the transmission of knowledge, in other words, a model for apprenticeship and technical replication (Fig. 16).

5. Conclusion and perspectives

The typological, technological, and functional approaches traditionally used to analyze bifacial tools are insufficient to understand the potential significance of these artifacts as they address only certain aspects of these multiple tools, namely their form, manufacture method, and function. In the future, these approaches should be complemented by a consideration of the underlying behavioral and social aspects embodied in the skill, anticipation of needs and mobility strategies inherent in these tools. The potential dichotomy evident in the function and status of expedient tools and those displaying a high degree of technical investment in the same assemblages represents a convincing example of the diversity of technical knowledge and skills possessed by different members of Neandertal hunter-gatherer groups.

Though the technological concept of bifacial tools exists and is present in different degrees throughout the numerous Late Middle Paleolithic assemblages from south-western France, it is likely that the artifact type we classify as a "biface" covers a broad range of tools and bifacial objects with multiple uses and roles, which vary depending on the period, context, circumstances and, perhaps, cultural groups. It is clear that, although most Neandertal groups possessed the know-how necessary to produce bifacial tools, the diversity of these tools is as much due to the variability of individual skill-levels and their implication in subsistence activities as it is connected to the still difficult to determine socio-cultural norms of these groups.

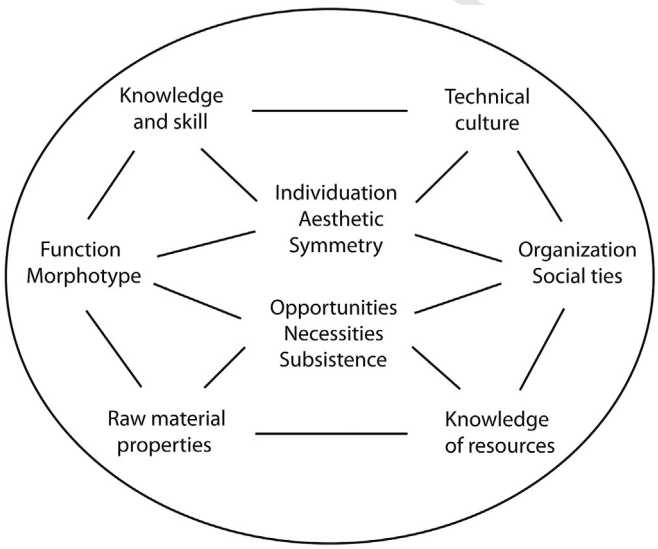

Fig. 16. Potential interpretive domains of bifacial tools. Without being exclusive, they can be closely combined and linked.

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